

Evaluation of mating disruption as part of an IPM program for navel orangeworm in almonds

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Experienced almond PCAs know that there is little room for error when battling navel orangeworm (NOW). Effective control requires a combination of good sanitation, well-timed insecticide sprays, and timely harvest, often followed by some sleepless nights while waiting for grade sheets to appear. Every year is a new adventure as complexities related to NOW and nut susceptibility make it difficult to predict damage levels, sometimes leaving growers disappointed, as routinely occurred in 2017.

Growers and PCAs that seek to improve their existing NOW management programs should consider mating disruption (MD). This technique uses dispensers to flood an orchard with synthetically-produced pheromone, thus interrupting the ability of male moths to find and mate with females. Reductions in the eggs occur if females fail to mate or if there is a delay in when mating occurs.

There are currently four different companies that have California labels for MD products. All four systems use similar amounts

of the same active ingredient, but each system dispenses the product differently. Some use active dispersion of pheromone from pressurized canisters hung in cabinets while one releases pheromone passively from plastic dispensers. Dispenser density varies from one to twenty per acre, and most have static release rates while one has the ability to manipulate rates wirelessly from a remote location. There are also differences in costs and value-added services related to installation, take-down, and pest monitoring services.

Field trials for MD of NOW have been ongoing for nearly a decade, mainly as privately-funded research in the southern San Joaquin Valley. These trials showed that use of MD can result in reductions in NOW damage, especially when used on thousands of contiguous acres. Our goal was to expand on that research to include all MD systems currently available, determine if NOW reductions can be seen on 40 to 100-acre plots more typical of many smaller growers, and determine if the benefits gained from MD are worth the costs.



Mating disruption field evaluations: 40-acre plots

During 2017 we evaluated four MD systems on 40-acre plots compared to an untreated check. These trials were funded by almond growers through the Almond Board of California. The MD systems were manufactured by four different companies and all released approximately the same amount of pheromone over the course of the season. The systems utilized active or passive dispersion of pheromone, different dispenser densities, and either static or variable rates of pheromone release. All systems were installed around April 1st onto 40-acre plots in three different orchards in Kern County. Each orchard had good winter sanitation and was sprayed once or twice with insecticides at hullsplit. In other words, we evaluated mating disruption as an added component to an existing IPM program, not as a replacement for sanitation or chemical control.

All four MD systems caused greater than 90% reductions in the capture of males in pheromone traps from April through September (Fig. 1). Egg captures during the same time period were reduced by 22% where MD was used. Across all orchards the average percentage of NOW-infested kernels was 2.28% for the no-MD checks compared to 1.13 to 1.33% for the four MD products. When all four MD products are averaged, MD reduced NOW damage by 35% in Nonpareil, 51% in Monterey and 55% in Fritz, with an overall reduction of 46% (Fig. 2).

Economic analyses were performed by calculating crop value using assumed per-acre yields of 1,500 lbs of nonpareil at \$2.50/lb and 1,500 lbs of pollinizers at \$2.25/lb base price, plus the addition of quality premiums according Blue Diamond’s 2017 Crop Quality Schedule. Where mating disruption was used, grower returns increased by an average of \$112 per acre. This was comparable to the cost of implementing mating disruption. In other words, adding MD to existing management programs on a 40-acre scale pays for itself. In the process, levels of NOW damage for nuts arriving at the huller were cut in half and risks of aflatoxin were reduced.

Mating disruption demonstration plots

As part of its mission to promote sustainable and environmentally-friendly pest management practices, the Department of Pesticide Regulation provided us with two years of funding to demonstrate IPM practices in almonds, including MD. Six side-by-side comparison orchards were established in the Central Valley (Wasco, Maricopa, Lost Hills, Turlock, Escalon and Ballico). Each trial compared approximately 60 to 100 acres of conventionally-grown almonds to adjacent orchards of similar size where MD was used. Four of the orchards were rectangular, whereas the other two were used to see if MD would work in orchards oriented as triangles.

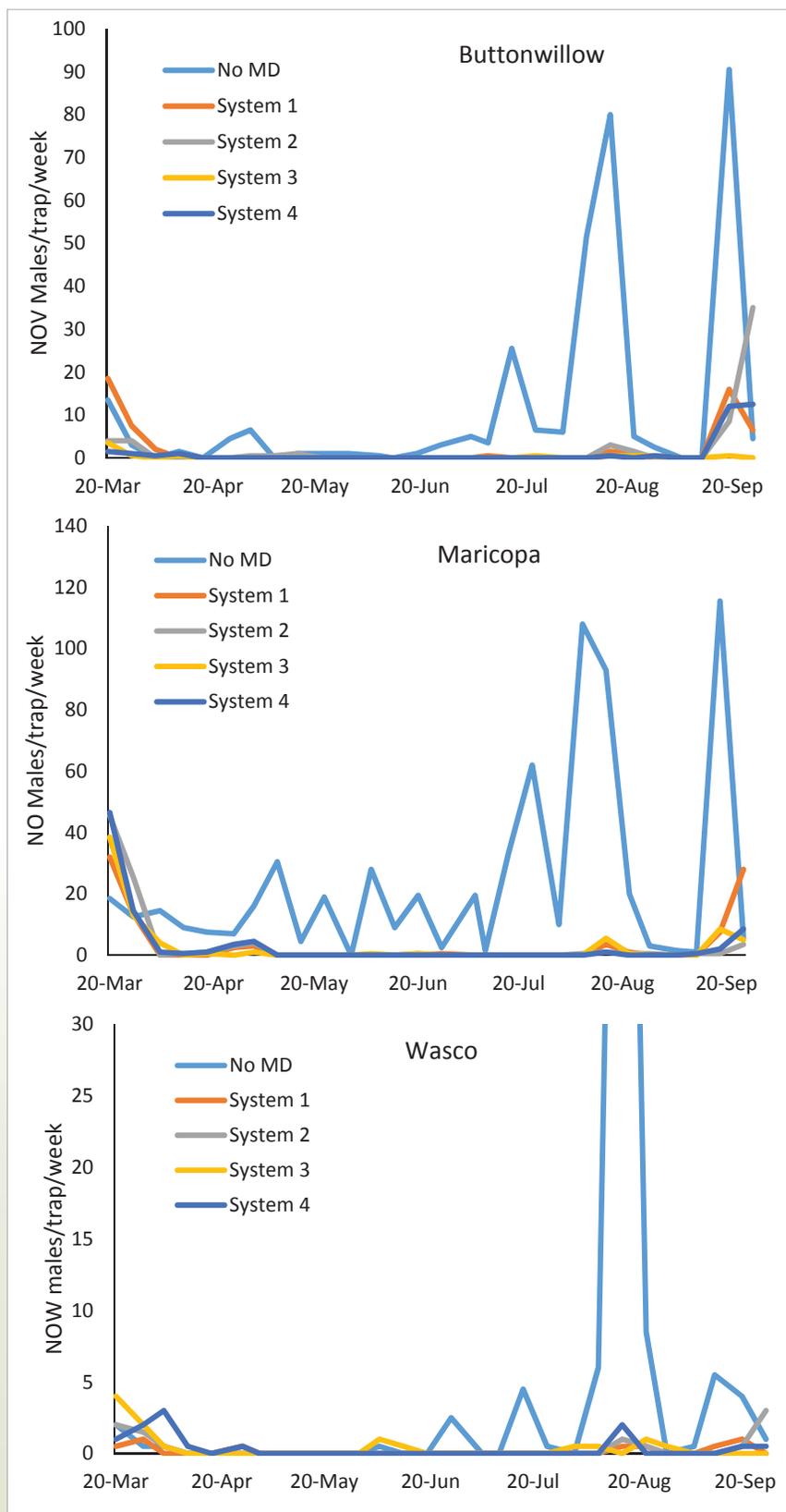


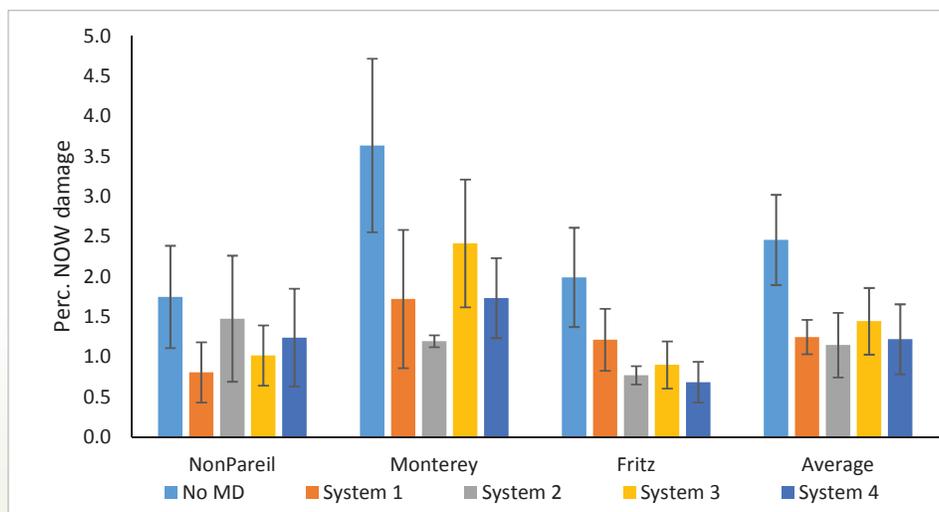
Figure 1. The effects of no mating disruption (MD) and four mating disruption systems on male navel orangeworm (NOW) captures in pheromone traps.

Table 1. The effects of adding mating disruption (MD) to conventional (conv.) IPM programs for navel orangeworm (NOW). HS: hullsplit

Philosophy	Southern San Joaquin Valley				Northern San Joaquin Valley			
	Wasco		Lost Hills		Turlock		Escalon	
	Conv.	MD	Conv.	MD	Conv.	MD	Conv.	MD
2017 Applications	HS + Post- HS Spray	MD (no spray)	HS spray	HS spray + MD	HS spray	HS spray + MD	HS spray	HS spray + MD
Trap captures (% change)	198	6 ↓97.2%	311	18 ↓94.2%	385	11 ↓97.1%	122	7 ↓94.7%
NOW Damage (% change)	0.11%	0.06% ↓73%	5.11%	0.97% ↓79%	0.90	0.45 ↓50%	5.65	1.3 ↓77%
Crop value ¹ (\$ change)	\$7,590	\$7,623 ↑\$34	\$7,376	\$7,740 ↑\$364	\$6,342	\$6,382 ↑\$40	\$6,029	\$6,363 ↑\$334

¹Crop value estimates assume yields of 3,000 lb/ac, base prices of \$2.50 for nonpareil and \$2.25 for pollinators, and quality premiums based on Blue Diamond's 2017 Crop Quality Schedule

Figure 2. The effects of no mating disruption (MD) and four mating disruption systems on percent (perc.) navel orangeworm (NOW) damage on 40-acre plots.



Across all sites, MD reduced the number of male NOW caught in pheromone traps by 93% from April through September. The average percentage of NOW damage was 2.59% in conventional orchards compared to 1.14% where MD was included. This is a reduction of 55.7%. When only the four rectangular orchards are evaluated, moth captures were reduced by 96% and the average reduction in damage improved to 76.4% (Table 1). When only considering the two triangular orchards, MD helped reduce male captures, but did not result in a reduction in damage at harvest.

Evaluation of the economic benefits of MD showed that grower returns increased by an average of \$122 per acre across all sites, and by \$222 per acre in the four rectangular orchards. Either way you look at it, adding MD paid for itself. Additionally, at one location with relatively low NOW pressure (Wasco), the grower successfully omitted two insecticide sprays in the MD orchard and still had less damage than where the sprays were used. These economic benefits on approximate 100-acre orchards are even larger than the benefits shown previously on 40-acre plots, confirming a long-known fact that the efficacy of MD systems improves as the contiguous acreage under MD increases.

Summary

All of our field work in 2017 suggests that incorporating MD for navel orangeworm in almonds in addition to an existing IPM program pays for itself when implemented on at least 40 acres, and generates a positive return on investment when implemented on at least 100 contiguous acres, all while reducing NOW damage and risk of aflatoxins. This statement assumes that the orchard is square to rectangular in shape. If the orchard has a high ratio of edges to middle (such as a triangle or a really long rectangle), growers who want to use MD should pair up with neighboring growers to make larger, more contiguous areas under MD to improve efficacy.

Mating disruption is compatible with, and should be used in conjunction with (not instead of), other historically-proven management techniques: namely winter sanitation, insecticide sprays, and early harvest. Mating disruption is recognized as a sustainable, environmentally-friendly tool for controlling pests that goes hand in hand with the Almond Board of California's Almond Sustainability (CASP) Program, and compliments almond growers' efforts to produce food products for health-conscious consumers around the world. ■